



STUDYGUIDE, DEPARTMENT OF BIOCHEMISTRY

SECOND YEAR MBBS (BATCH 2026)



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DEPARTMENT OF BIOCHEMISTRY

HISTORY, AIM AND TEACHING STRATEGY

Introduction

BIOCHEMISTRY Department was established in Bahawalpur Block of King Edward Medical University in 1916. The department is providing teaching and training to M.Phil., MBBS, BDS, DPT and other disciplines under the supervision of Prof. Dr. Nakhsahab Choudhry efficiently. The teaching faculty includes the professor, One Associate Professors, Three Assistant Professors, and Three Demonstrators. The level of education for all the disciplines is maintained efficiently by implementation of concepts, skills, advance Knowledge and teaching methods. Many research projects are in progress in our department. The departmental representation in extra-curricular activities is also marked. The department is working hard to fulfill requirements in teaching and training the students who can lead the race of medical profession.

AIMS

To create interest in studying Biochemistry and train students to make them finest so that they can compete and deliver best in medical profession by providing conducive environment.

TEACHING STRATEGY

Use of bridge in, objective based, pretest, participatory/interactive lecture, problem based learning, assessment of test questions according to standardized key, post-test discussion, and summarizing strategies for improving knowledge of students.

MESSAGE OF THE VICE CHANCELLOR, PROF.DR.MAHMOOD AYYAZ

I am honored to step into the educational leadership of the King Edward Medical University. As its Vice Chancellor, I will strive to maintain the tradition of strong, insightful, and forward-thinking leadership of my predecessors. While the challenges and research opportunities in the future will be decidedly different from those faced by the university's previous leaders, but the principles of dedication to outstanding high-impact science, community participation, accountability, and transparency in the decision-making process will guide my vision for the university

As its Vice Chancellor, I am capable of fully embracing the challenges and opportunities that lie ahead and take this as unique opportunity to help shape the future of the medical education and research in my country and will work hard to further vitalize the University by enfolding new and exciting areas of growth and development particularly in Clinical Informatics and Data Sciences.

As a Vice Chancellor, I envision to:

- Provide Academic and Scientific leadership for the University.
- Promote scientific inquiry and discovery to generate new knowledge, Identify promising pathways, pursue novel targets, develop innovative diagnostics, and design effective interventions that bring hope and health to the human condition.
- Create opportunities to understand how human health is affected by Medical Education and Research and how this knowledge can be used to reduce morbidity, improve quality of life, and extend longevity.
- Modernize and Standardize Induction, Training, Monitoring and Evaluation in the Under and post graduate programs of the university.
- Create a forum for open and ongoing communication between the University and both the public and scientific communities to identify areas for programmatic development, to fully evaluate a problem or opportunity, and to enhance public and scientific awareness of the problem and find a solution, and, when appropriate, coordinate these activities with programmatic efforts with other National and International universities
- Foster the development of programmatic, interdisciplinary research with the Mechanical, Electrical, Textile and Environmental Science Industry of Pakistan and support the development of research careers in these fields
- Work with the other institutes like NIH, the Centers for Disease Control and Prevention, the Environmental Protection Agency, and other relevant scientific institutes to coordinate scientific and training programs.
- Serve as a spokesperson of the University to the Government in Medical Education and Science.

I believe that the University will benefit from my perspective as an active Surgeon–Scientist. The reasons for this are simple and straightforward, I enjoy patient care and research, I see these activities as part of my identity, and throughout my career my research has been driven and inspired by taking care of patients with complex and unexplainable illnesses.

I am very excited about my role in the future with the University and am fully committed to serving as its Vice Chancellor. I have decided to take on this responsibility because of my long- Standing commitment to Medical education and patient care and my firm belief in our collective responsibility to advance society. With the Blessings of Allah Almighty, I look forward to the work ahead with **ALTAPETE** as my motto and the ALUMINI of King Edward Medical University as my guiding light.

BIOCHEMISTRY DEPARTMENT
KING EDWARD MEDICAL UNIVERSITY, LAHORE
VISION AND MISSION STATEMENT

VISION

The vision of the Department of Biochemistry is to be a premier center for biochemical excellence, recognized globally for integrated medical education and transformative research that empowers undergraduate and postgraduate scholars to improve healthcare outcomes.

MISSION

The Department of Biochemistry at King Edward Medical University is committed to:

- Providing comprehensive and high-quality education in Biochemistry, molecular biology, and molecular genetics, fostering a strong foundation for evidence-based and laboratory-informed medical practice along with promoting innovative research in Biochemistry and molecular genetics.
- Developing competent and ethically responsible health care professionals well versed in advance diagnostics, encouraging lifelong learning with critical thinking and analytical reasoning.

INTRODUCTION TO STUDY GUIDE

Dear student,

Welcome to the Second year Biochemistry Course. The department of Biochemistry will be facilitating the course. There are two other basic sciences departments to assist in your learning. You will spend 288 study hours in second year, learning the different aspects of the subject.

The purpose of the study guide is to help you learn the subject of Biochemistry. It is designed to help you manage your learning and access the resources available to you. It takes you through the general objectives of learning the subject, divides the subject into modules for easy learning and helps you understand the course work, clinical skills and attitudes that are desired of a good doctor.

The basic sciences courses you do in the first three years are pre-requisites for the clinical side teaching and will help you in better understanding of the clinical subjects and its application to actual patients. We advise you to study these subjects if there are any issues in understanding the Biochemistry. We hope you will realize how integrated these subjects are to your clinical practice.

Methods of assessment have also been written so that you can relate teaching to assessment and have a fair idea of the assessment methods and what internal and external assessment is all about.

We hope the students take time out to go through the guide and to use it effectively to learn the subject of Biochemistry. We look forward to feedback from the students and faculty so that the guide can be to improved further.

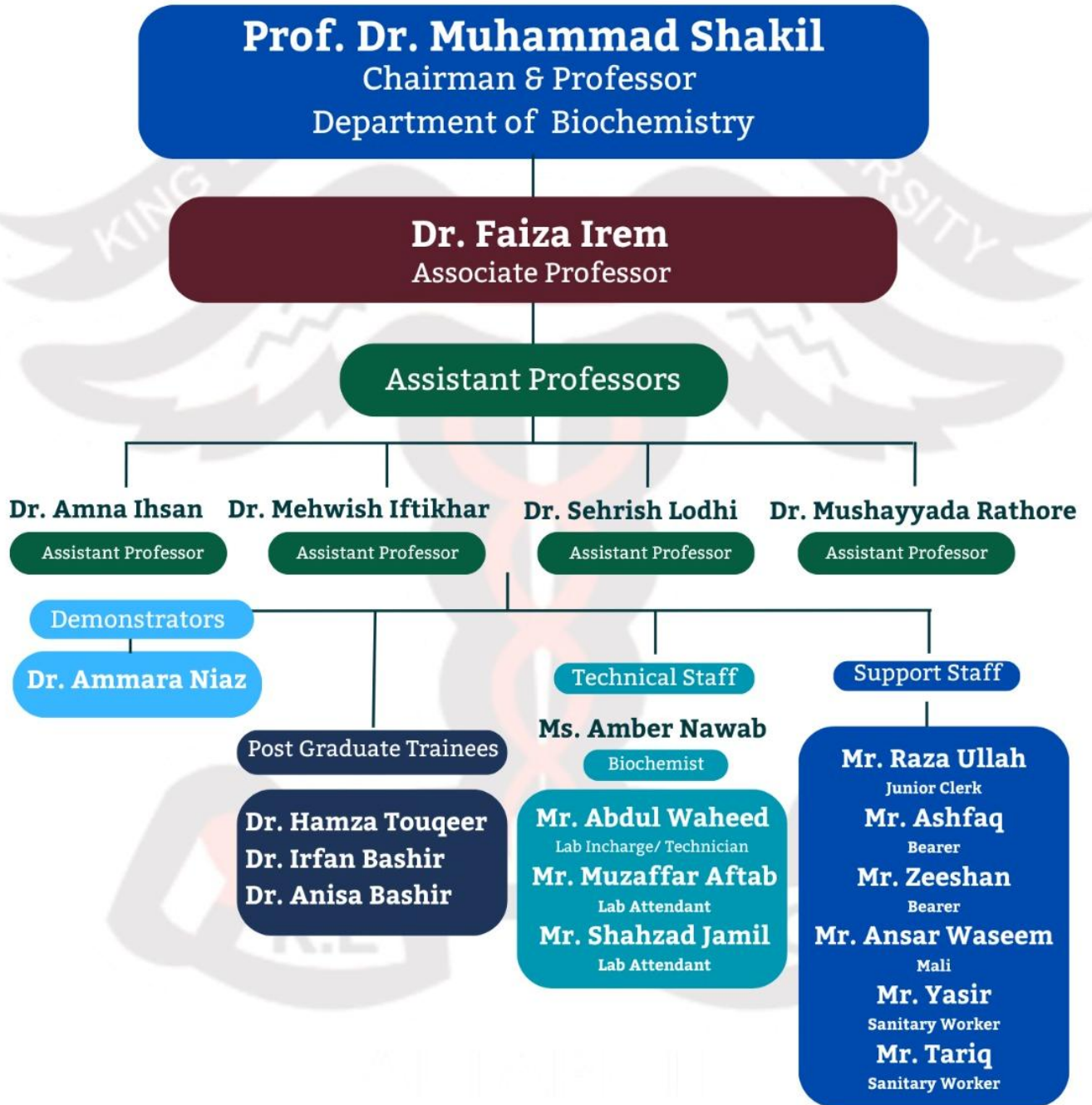
For any assistance please do not hesitate to contact the teaching faculty of the department of Biochemistry. (Details available at KEMU website and student section office). Alternatively, please feel free to visit the head of the department for any issues that you face in learning of the subject or otherwise.

We hope that your stay in our department will be very fruitful and enjoyable and will equip you for future practical life.

With compliments from:

Head of department and faculty members, Department of Biochemistry.

**ORGANOGRAM, DEPARTMENT OF BIOCHEMISTRY
KING EDWARD MEDICAL UNIVERSITY, LAHORE**



LEARNING OUTCOMES

SECOND YEAR BIOCHEMISTRY:

Learning Goal:

The course aims to teach MBBS students the principles and details of Bioenergetics, Electron Transport Chain and its relation to generation of ATP. It would help to understand energy transformations in various metabolic reactions and their role in the synthesis of biological molecules. This would also include digestion, breakdown and reutilization of various bio molecules formed during the course of metabolism along with their regulation for the purpose of homeostasis. It would give them a grasp on the basic concepts of metabolic disorders, their manifestations, and role of biochemical investigations in diagnosis of metabolic disorders. At the end of this course students will be able to correlate the role of above-mentioned biochemical processes in integration of metabolism.

Learning Objectives/ Outcomes:

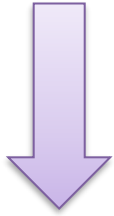
By the end of the course, the 2nd year students should be able to:

1. Discuss the concept of redox reactions, redox couples, along with enzymes and coenzymes of biological oxidation and reduction.
2. Describe the process of respiratory chain, its components, role of electron flow in oxidative Phosphorylation, ATP Synthase in synthesis of ATP along with their inhibitors & uncouplers.
3. Illustrate the processes & energetic of glycolysis, gluconeogenesis along with their reversible, irreversible steps catalyzed by specific enzymes and regulation of blood glucose level.
4. Explain the Reactions of Citric acid cycle, Cori's cycle, glycogenesis and glycogenolysis, Hexose Mono Phosphate (HMP) shunt, Uronic acid pathway.
5. Discuss digestion, absorption of carbohydrates and metabolism of Monosaccharides, Disaccharides.
6. Discuss disorders related to monosaccharide, disaccharide metabolism along with their diagnosis on the basis of biochemical tests & their complications.
7. Classify glycogen storage diseases on the basis of enzyme deficiency, their related metabolic pathways, clinical manifestations, complications.
8. Describe Mobilization, transport, synthesis, oxidation & regulation, of fatty acids, TAGs, sterols, phospholipids & glycolipids.
9. Enumerate ketone bodies, eicosanoids, plasma lipoproteins, their various types, synthesis, degradation and utilization.
10. Illustrate steps of cholesterol synthesis, its fate, functions, regulation and associated disorders.

11. Describe disorders related to fatty acid oxidation, triglyceride & ketone bodies synthesis, cholesterol & lipoprotein metabolism.
12. Illustrate the pathway involved in congenital adrenal hyperplasia
13. Explain steps of amino acid oxidation, their metabolic fate, including various processes of nitrogen transfer, nitrogen excretion, ammonia intoxication, urea formation, Urea cycle and its regulation along with genetic defects of urea cycle.
14. Discuss disorders related to urea synthesis, ammonia disposal, and amino acid metabolism.
15. Describe the functions, pathways of amino acid degradation and genetic disorders of individual amino acids
16. De novo synthesis of purines, pyrimidines, their recycling, degradation and related disorders
17. Draw the concept map showing the integration of metabolic pathways in different tissues
18. Describe basic concepts of genetics and molecular biology
19. Describe function of endocrine glands and their disorders
20. Classify and describe acid base disorders
21. Discuss cancer and xenobiotics

CURRICULUM MAP

You will study details here



First year	Second Year	Third Year	Fourth Year	Final Year	House Job
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You are currently in preclinical side of Medical college. You are going to study general Principles of Biochemistry along with other basic subjects like Physiology and Anatomy. In second year you are supposed to attend lectures, tutorials and perform practicals in biochemistry lab.

In final assessment all these parameters are evaluated so learn carefully and revise it very often till your final professional examination.

TEACHING SCHEDULE

<u>THEORY:</u>	
Starting date of the session	28-01-2026
Venue	Biochemistry Lecture Hall 2 Maqbool Ahmed Block
Course coverage	9 Months
No. of total lectures	Four Lectures/week
Days of Biochemistry lectures	One lecture each on Monday, Wednesday, Thursday, and Friday of each week.

<u>PRACTICALS</u>	
Starting date of the session	28-01-2026
Venue	Biochemistry Laboratory
Days of Biochemistry Practicals	Monday, Tuesday, Thursday and Saturday

<u>TUTORIALS/SMALL GROUP DISCUSSIONS</u>	
Starting date of the session	28-01-2026
Venue	Demonstration Rooms in Biochemistry department.
Days of Biochemistry tutorials/Problem based learning	Monday, Tuesday, Thursday and Saturday

Time Table: Second Year MBBS



Office of The Professor of Anatomy Department, KEMU.

Time Table of 2nd Year MBBS (2026-2027) Classes

Day	08:00 - 09:00	09:00 - 10:00	10:00 - 10:30	10:30 - 11:30	11:30-12:30	12:30 - 02:30
Monday	Anatomy Demonstration	Anatomy Dissection	B R E A K	Anatomy Lecture (Histology)	Biochemistry Lecture (Lecture Theatre 02)	Practical Histology C Physiology A Biochemistry B Biochemistry Tutorial D
Tuesday	Anatomy Demonstration	Anatomy Dissection		Anatomy Lecture (Histology)	Physiology Lecture	Practical Histology A Physiology B Biochemistry D Biochemistry Tutorial C
Wednesday	Anatomy Lab			Biochemistry Lecture (Lecture Theatre 02)	Physiology Lecture	Tutorial Physiology
Thursday	Anatomy Demonstration	Anatomy Dissection		Physiology Lecture	Biochemistry Lecture (Lecture Theatre 02)	Practical Histology D Physiology C Biochemistry A Biochemistry Tutorial B
Friday	Integrated Lecture / Pakistan Studies	Anatomy Lecture (Embryology)	(10:00-11:00) Biochemistry Lecture		11:00-12:00 Physiology Lecture	
Saturday	Anatomy Demonstration	Anatomy Dissection	B r e a k	Anatomy Lecture (Embryology)	Physiology Lecture	Practical Histology B Physiology D Biochemistry C Biochemistry Tutorial A

Lectures of Anatomy and Physiology will be delivered in Anatomy & Physiology Lecture Theatres, and Lectures of Biochemistry will be delivered in the Lecture Theatre 02 of Maqbool Ahmed Block.

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21.01.26
Prof. Dr. Tehreem Fatima
Dean Basic Sciences
Head of Anatomy Department
King Edward Medical University, Lahore.

Shakil
Prof. Dr. Muhammad Shakil
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Head of Physiology Department,
King Edward Medical University, Lahore.

TEACHING METHODOLOGIES

- Lectures(Interactive, student-centered, outcome based)
- Practicals
- Tutorials/Problem based learning sessions
- Individual presentations
- Regular Class test/assessment at the end of each Topic
- Send-Up Examination
- Viva Voce

SYLLABUS OUTLINE WITH LEARNING OUTCOMES

SECOND YEAR MBBS

According to PM&DC & King Edward Medical University guide lines, following topics and their relevant lab work and PBLs will be taught in Second Year MBBS:

1. Bioenergetics and Biologic Oxidation
2. Metabolism of Carbohydrates
3. Metabolism of Lipids
4. Metabolism of Proteins and Amino Acids
5. Integration and Regulation of Metabolic Pathways
6. Metabolism of Nucleotides.
7. Basis of Genetics & Molecular Biology
8. Biochemistry of Endocrine System
9. Acid base regulation
10. Cancer and Xenobiotics
11. Biochemistry of Digestive tract

1. Bioenergetics and Biologic Oxidation

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Discuss the concept of redox reactions and redox couples,
2. Describe enzymes and coenzymes of biological oxidation and reduction.
3. Describe the process of respiratory chain and its components.
4. Describe the role of electron flow in oxidative Phosphorylation, ATP Synthase in synthesis of ATP along with their inhibitors & uncouplers.

Course Content:

- a. Endergonic and Exergonic reactions, Free energy, Free energy change, ATP and other compounds as carriers of energy.
- b. Electron transport chain: components and organization of electron transport chain (ETC).
- c. Reactions of Electron transport chain (ETC), Redox potential, Methods of Electron transfer among the components of Electron transport chain, and energy release during electron transport.
- d. Oxidative phosphorylation: ATP synthesis in ETC, Inhibitors and Uncouplers of Oxidative phosphorylation, and Chemiosmotic hypothesis of Oxidative phosphorylation.

2. Metabolism of Carbohydrates

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Illustrate the processes & energetic of glycolysis, gluconeogenesis along with their reversible, irreversible steps catalyzed by specific enzymes and regulation of blood glucose level.
2. Explain the Reactions of Citric acid cycle, Cori's cycle, glycogenesis and glycogenolysis, Hexose Mono Phosphate (HMP) shunt, Uronic acid pathway.
3. Discuss digestion, absorption of carbohydrates and metabolism of Monosaccharides, Disaccharides.
4. Discuss disorders related to monosaccharide, disaccharide metabolism along with their diagnosis on the basis of biochemical tests & their complications.
5. Classify glycogen storage diseases on the basis of enzyme deficiency, their related metabolic pathways, clinical manifestations, complications.

Course Content:

a. Glycolysis

- Reactions of Aerobic and Anaerobic Glycolysis occurring in RBCs and other tissues.
- Biomedical significance and Energy yield of Aerobic and Anaerobic Glycolysis.
- Regulation of Glycolytic pathway.
- Metabolic fates of Pyruvate.
- Lactic acidosis; Genetic deficiency of Pyruvate kinase and Pyruvate dehydrogenase.

b. Tricarboxylic acid (TCA) cycle.

- Reactions of TCA cycle and their regulation along with energy yield.
- Importance of TCA cycle and its Amphibolic role.

c. Gluconeogenesis.

- Reactions of Gluconeogenesis using Pyruvate and Glycerol as precursors, and regulation of Gluconeogenesis.
- Important Gluconeogenic precursors; Entrance of amino acids, Intermediates of TCA cycle, Glycerol, and other compounds as Gluconeogenic precursors.
- Biomedical significance of Gluconeogenesis: Role of Gluconeogenesis in plasma Glucose level regulation, and the Cori's cycle, and Glucose-Alanine cycle.

d. Glycogen Metabolism.

- Synthesis and importance of UDP glucose.
- Reactions of Glycogenesis and Glycogenolysis.
- Regulation of Glycogenic synthase and Glycogen phosphorylase.
- Importance of allosteric regulation of Glycogen phosphorylase 'a' (a plasma glucose sensor) by plasma glucose.
- Disorders of Glycogen metabolism (Glycogen storage diseases).

e. The Hexose Monophosphate pathway (HMP) and other pathways of Hexose metabolism.

- Hexose monophosphate (HMP) pathway: Reactions of Oxidative and Non-oxidative phases of HMP pathway, importance of HMP pathway along with uses of NADPH, and Gu cose 6-phosphate dehydrogenase. (G-6PD deficiency).
- Reactions of Uronic acid pathway along with its Biologic importance.
- Metabolism of Fructose: Metabolic fate of fructose in human body, Sorbitol metabolism along with effects of hyperglycemia on Sorbitol metabolism, Essential fructosuria and hereditary fructose intolerance.
- Metabolism of Galactose: Metabolic fate of Galactose in body and synthesis of Lactose; and disorders of Galactose metabolism (Galactokinase deficiency and Classic Galactosemia).

- Metabolism of Ethanol.
- f. Regulation of Blood Glucose level.
- Regulation of plasma glucose hormonally (Insulin, Glucagon, Growth hormone, Epinephrine, and Cortisol) and non-hormonally, and the role of various metabolic pathways in blood glucose level regulation.
- Hypoglycemia and Hyperglycemia: an overview of Hypoglycemia and Hyperglycemia, their important causes, and clinical manifestations.
- Diabetes Mellitus: Types of Diabetes Mellitus along with its Clinical manifestations, Metabolic changes in Type 1 and Type 2 Diabetes Mellitus, and Diagnosis of Diabetes Mellitus.

3. Metabolism of Lipids

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Describe Mobilization, transport, synthesis, oxidation & regulation, of fatty acids, TAGs, sterols, phospholipids & glycolipids.
2. Enumerate ketone bodies, eicosanoids, plasma lipoproteins, their various types, synthesis, degradation and utilization.
3. Describe metabolism of Phospholipids and Sphingolipids
4. Illustrate steps of cholesterol synthesis, its fate, functions, regulation and associated disorders.
5. Describe Biosynthesis and Fate of Bile acids and their significance in health and disease.
6. Describe disorders related to fatty acid oxidation, triglyceride & ketone bodies synthesis, cholesterol & lipoprotein metabolism.
7. Describe fatty liver

Course Content:

- a. De novo synthesis of Fatty acid: Production of cytosolic acetyl CoA, Fatty acid synthase multi enzyme complex, Reactions of cytosolic fatty acid synthesis, Elongation of fatty acid chain, Synthesis of Polyunsaturated fatty acid, and Regulation of fatty acid synthesis.
- b. Synthesis and storage of Triacylglycerol's (TAG) in body.
- c. Mobilization of stored Triacylglycerol (TAG) along with its regulation.
- d. Synthesis of Eicosanoids, their regulation and functions along with their biomedical importance.
- e. Metabolism of Phospholipids and Sphingolipids: Synthesis of Phospholipids (phosphatidyl choline and phosphatidyl ethanolamine), Synthesis of Glycerol Ether Phospholipids (Cardiolipin and Platelet

activating factor), Degradation of Phospholipids, Deficiency of Lung Surfactant, Metabolism of Glycolipids, Biosynthesis of Ceramide, Sphingomyelin, and Gangliosides ,and Degradation of Sphingolipids along with Sphingolipidoses.

- f. Cholesterol Metabolism: Reaction and Regulation of Cholesterol biosynthesis, and Fate and functions of Cholesterol in body.
- g. Biosynthesis and Fate of Bile acids and their significance in health and disease.
- h. Plasma lipoproteins: Synthesis, transport, and fate of chylomicrons, VLDL, IDL, LDL and HDL; Disorders associated with Impairment of Lipoprotein metabolism , and Athero genic effect of oxidized LDL.
- i. Biochemical defects leading to Fatty liver.

4. Metabolism of Proteins and Amino acids

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

- 1. Explain steps of amino acid oxidation and their metabolic fate, including various processes of nitrogen transfer, nitrogen excretion and ammonia intoxication
- 2. Describe the process of urea formation, Urea cycle and its regulation along with genetic defects of urea cycle.
- 3. Discuss disorders related to urea synthesis, ammonia disposal, and aminoacid metabolism.
- 4. Describe the functions, pathways of each amino acid synthesis and degradation and genetic disorders of individual amino acids
- 5. Discuss intermediates formed from the carbon skeleton of amino acids.
- 6. Describe metabolism of nitrogen containing compounds.

Course Content:

- a. An overview of Protein turnover in Human body; Nitrogen Balance (Positive and Negative).
- b. Inter-organ Amino Acid exchange in Normal Post-absorptive state.
- c. Degradation of Amino acids; Removal of nitrogen from Amino Acids by Transamination and Deamination ; Sources of Ammonia in body ; Transport of ammonia , Ammonia toxicity; Fate of Ammonia in body , Reactions and Regulation of the Urea cycle along with Metabolic disorders of the Urea cycle.
- d. An overview of amphibolic intermediates formed from the carbon skeleton of amino acids.
- e. Concept of Glucogenic and Ketogenic amino Acids; an outline of the metabolism of individual amino acids like Glycine, Cysteine, Arginine ,Proline , Phenylalanine , Tyrosine , Histidine,Tryptophan , Methionine . Causes and silent features of important metabolic defects in Amino acid metabolism like

Phenylketonuria , Maple Syrup Urine disease (MSUD), Histidinemia , Alkaptonuria ,Cystathioninuria, Homocystinuria , Hyperprolinemia, Cystinuria, Cystinosis,Tyrosinemias, and Albinism.

- f. Metabolism of Epinephrine and Norepinephrine, Creatine, Creatinine, Histamine, Gamma-Aminobutyrate, Serotonin, Melatonin, and Melanin.

5. Integration and Regulation of Metabolic Pathways

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

- a. Define Fed-fast cycle and Starvation.
- b. Describe Metabolism, Anabolic and Catabolic pathways.
- c. Draw the concept map showing the integration of metabolic pathways in different tissues

Course Content:

- a. Fed-fast cycle and Starvation.
- b. Basic concept of Intermediary Metabolism, Introduction of Anabolic and Catabolic pathways.
- c. An overview of regulation and integration of various metabolic pathways. (Role of Liver, Heart, Brain, Skeletal Muscle and Adipose tissue).

6. Metabolism of Nucleotides.

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Describe De novo synthesis of purines, pyrimidines, their recycling, degradation and related disorders
2. Discuss derivatives of Purines and Pyrimidines and their role in Health and Disease

Course Content:

- a. De novo synthesis of Purines and Pyrimidines; the Salvage Pathways of Nucleotide Synthesis; Degradation of Purine and Pyrimidine Nucleotides.
- b. Disorders Associated with Purine Nucleotides Metabolism like Adenosine Deaminase Deficiency, Purine Nucleoside Phosphorylase Deficiency, and Hyperuricemia.
- c. Natural and Synthetic derivatives of Purines and Pyrimidines and their role in Health and Disease.

7. Basis of Genetics & Molecular Biology

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Describe genes & chromosomes
2. Explain DNA and RNA metabolism
3. Describe the process of protein synthesis
4. Discuss regulation of gene expression
5. Discuss Molecular Biology Techniques

Course Content:

- a. The Structural basis of Cellular Information.
- b. Organization of DNA: Chromosomes, karyotyping.
- c. Replication of DNA: Reactions of DNA Replication in Eukaryotes and Prokaryotes: Types of damage to DNA and DNA repair; Mutations.
- d. Genetic Basis of Disease.
- e. Transcription (DNA-dependent RNA synthesis): Steps in the Transcription of Eukaryotic and Prokaryotic genes; Post –Transcriptional Modifications (processing) of RNA; Reverse Transcription in Retroviruses and its relation to Cancers and AIDS.
- f. Translation (Protein Synthesis): The Genetic code; Components required for Protein synthesis; Composition of Eukaryotic and Prokaryotic Ribosomes; Steps of Protein Synthesis; Post-Translational Modifications of Polypeptide Chains; Protein Targeting.
- g. Regulation of Gene Expression in Prokaryotes and Eukaryotes.
- h. Molecular Biology Techniques: Basic Information and Biomedical Importance of Molecular Biology Techniques; DNA Extraction: Recombinant DNA Technology; DNA Cloning; Polymerase Chain Reaction (PCR); Hybridization; Blotting Techniques.

8. Biochemistry of Endocrine System

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Describe Classification of Hormones and Mechanisms of Action of each class of Hormone
2. Describe synthesis, secretion, mechanism of action, effects on target tissues, regulation, and related disorders of hormones of endocrine glands.

Course Content:

- a. An overview of Endocrine System; Classification of Hormones based on their Mechanism of action and Chemical Nature; Mechanisms of Action of each class of Hormone: General Characteristics of various types of Hormone Receptors; Types and Actions of Various kinds of G-proteins in mediating the actions of Hormones; Signal Transduction Pathways of Various Hormones; Types and role of various kinds of Second Messengers.
- b. Pituitary and Hypothalamic Hormones : Structure , Biosynthesis ,Secretion, Transport, Regulation, Catabolism, and Biologic Actions of all Hypothalamic and Pituitary Hormones; Disorders associated with Hyper-and Hypo-activities of these Hormones such as Growth hormone deficiency(dwarfism),Gigantism, Acromegaly, Cushing's Syndrome, Addison's disease, Diabetes Insipidus, and the inappropriate secretion of ADH(SIADH).
- c. Thyroid Hormones; Structure, Biosynthesis, Secretion , Transport, Regulation , Catabolism, and Biologic Actions of all Thyroid Hormones ; Disorders Associated with Hyper- and Hypo activities of these Hormones like Goiter, Hypothyroidism, Hyperthyroidism, Graves' disease.
- d. Calcium Regulating Hormones: Structure, Biosynthesis, Secretion , Transport, Regulation , Catabolism ,and Biologic actions of Parathyroid Hormone; Disorders associated with Hyper-and Hypo-activities of these hormones ; Role Parathyroid Hormone, Calcitriol, and Calcitonin in Calcium Homeostasis; Hypoparathyroidism, Hyperparathyroidism (Primary ,Secondary, and Tertiary). Pseudohypoparathyroidism, Rickets, and Osteomalacia).
- e. Adrenal Cortical Hormones: Structure , Biosynthesis, Secretion , Transport, Regulation, Catabolism , and Biologic actions of all Adrenal Cortical Hormones; Disorders associated with Hyper- and Hypo-activities of these hormones like Cushing's disease / Syndrome, Secondary Adrenal Deficiency, Addison's disease, Primary Aldosteronism and Secondary Aldosteronism.
- f. Adrenal Medullary Hormones: Structure, Biosynthesis, Secretion Transport, Regulation , Catabolism , and Biologic actions of all Adrenal Medullary Hormones; and Associated disorders like pheochromocytoma.
- g. Male and Female Gonadal Hormones: Structure , Biosynthesis, Secretion , Transport, Regulation, Catabolism , and Biologic actions of all Male and Female Gonadal Hormones; disorders associated with Hyper-and Hypo – Activities of these hormones like; Hypergonadism and Hypogonadism in Male and Female.
- h. Hormones of Pancreas: Structure , Biosynthesis, Secretion, Transport, Regulation, Catabolism, and Biologic action of all Pancreatic Hormones (Insulin ,Glucagon, Somatostatin and Pancreatic Polypeptide); Disorders associated with Hyper- and Hypo- activities of these hormones like; pathophysiology of Insulin deficiency and Diabetes Mellitus.

9. Acid base regulation

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Classify and describe acid base disorders
2. Can do clinical interpretation of laboratory report of arterial blood gases.

Course Content:

- a. Biochemical mechanisms to regulate water and electrolyte balance in body: fluid compartments of the body: gain and loss of body water: regulation of body water balance, effects of pure water deprivation, water excess or water intoxication; and electrolytes of body fluids (sodium, potassium, magnesium and chloride).
- b. Body buffer system, role of lung and kidney in maintenance of acid- base balance.
- c. Acid-base disturbance in the body like respiratory and metabolic acidosis (lactic acidosis and ketoacidosis); respiratory and metabolic alkalosis; concept of anion gap, base excess and base deficit.
- d. Clinical interpretation of laboratory report of arterial blood gases.

10. Cancer and Xenobiotics

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Describe Oncogenes and their Role in Carcinogenesis
2. Define Tumour Suppressor Gene
3. Explain Important Tumor Markers and their Clinical Significance
4. Discuss how drugs and other xenobiotics are metabolized in the body.
5. Describe the metabolic importance of glutathione.
6. Appreciate that xenobiotics can cause pharmacologic, toxic, immunologic, and carcinogenic effects.

Course Content:

- a. Oncogenes and their Role in Carcinogenesis; Mechanisms of Activation of Proto- Oncogenes; Mechanism of Action of Oncogenes; Tumour Suppressor Gene and Oncogenic Viruses.

- b. Important Tumor Markers and their Clinical Significance(Carcinoembryonic antigen(CEA) α - Fetoprotein, Human Chorionic gonadotropin (hCG), Calcitonin and Prostatic acid Phosphatase).
- c. Xenobiotics
 - Discuss how drugs and other xenobiotics are metabolized in the body.
 - Describe the two general phases of xenobiotic metabolism, the first involving mainly hydroxylation reactions catalyzed by cytochrome P450 species and the second conjugation reactions catalyzed by various enzymes.
 - Describe the metabolic importance of glutathione.
 - Appreciate that xenobiotics can cause pharmacologic, toxic, immunologic, and
 - carcinogenic effects.

11. Biochemistry of Digestive tract

Learning Objectives/ Outcomes:

By the end of this topic, students should be able to:

1. Describe composition and regulation of various digestive juices of GIT
2. Describe digestion and absorption of carbohydrates, lipids, proteins, and nucleic acids in gastrointestinal tract.
3. Discuss actions of gastrointestinal hormones

Course Content:

- a. Introduction, chemical composition, and secretion and regulation of various digestive juices of GIT such as saliva, gastric juice & HCl, pancreatic juice, bile, and succus entericus.
- b. Hydrolysis (digestion) of carbohydrates, lipids, proteins, and nucleic acids in gastrointestinal tract.
- c. Absorption of carbohydrates, lipids and amino acids.
- d. Disease states associated with GIT disorders like achlorhydria, peptic ulcers, lactose intolerance, cholelithiasis and pernicious anemia, cystic fibrosis and celiac disease.
- e. Site of synthesis and major actions of gastrointestinal hormones like gastrin, cholecystokinin (CCK) , secretin , gastric inhibitory peptide (GIP), vasoactive intestinal polypeptide (VIP) , motilin , enkephalins, substance P , neurotensin , and enteroglucagon.

LECTURES & TUTORIALS

Sr. No	2 nd YEAR (MBBS)		
	Topics	No. of Lectures	No. of Tutorials
1.	Biological Oxidation	7	2
2.	Carbohydrates Metabolism	18	5
3.	Lipids Metabolism	18	4
4.	Protein & Amino Acids Metabolism	15	4
5.	Nucleotides Metabolism	7	3
6.	Integration of Metabolic Pathways	5	1
7.	Biochemical Genetics/ Molecular Biology	26	6
8.	Endocrinology	8	2
9.	Water & Electrolyte balance, Acid-Base Regulation	6	2
10.	Cancer and Xenobiotic	5	1
11.	Biochemistry of Digestive Tract	3	2

SKILLS - PRACTICALS

SECOND YEAR MBBS:

- The introduction of techniques and instrumentation of clinical biochemistry like centrifugation, spectrophotometry (visible, UV, infra-red and atomic absorption). pH metry, chromatography, electrophoresis, enzyme-linked immunosorbent assay (ELISA), micro pipetting, flame photometry and ion selective electrode (ISE) technique
- Collection, preservation, and storage of blood sample
- Estimation of various substances in blood and other biological fluids , like glucose , Creatinine, urea, protein, albumin, uric acid, and calcium, total cholesterol; HDL Cholesterol, and triacylglycerol; demonstration of Creatinine clearance; and oral glucose tolerance test (OGTT)
- Determination of plasma enzyme activities of alanine amino transferase (ALT) ,aspartate amino transferase (AST), amylase, creatine phosphokinase (CK), alkaline phosphatase (ALP), and lactate dehydrogenase (LDH)
- Clinical interpretation of common laboratory values of the compounds and enzymes as listed above.
- Determination of amino acids in urine by paper chromatography (demonstration)

TIME LINE FOR COURSE COVERAGE & ACADEMIC CALENDAR

- **Course Duration:** 9 months (32 weeks of active session)
- **Total lectures:** 128 lectures (4 lectures per week).
 - Basic Biochemistry Lectures.
 - Clinically oriented lectures
- **Practicals:** One/week for each batch for two hours
- **Tutorials/Problem based Learning Sessions:** One/week for each batch for two hours

ACADEMIC CALENDER 2025-2026

	SECOND YEAR MBBS
Session	28-1-2026 – 28-10-2026
1st Class Test	16-03-2026
2nd Class Test	1 st week of June 2026
3rd Class Test	Mid September 2026
Practical Test	October 2026
Sendup	End of November 2026
Professional Examination	December 2026-January 2027

TEACHING/CONTACT HOURS

- **Total teaching/contact Hours: 256**
- Contact hours for Lectures: $128 \times 1 = 128$ hours
- Contact hours for Practical: $32 \times 2 = 64$ hours
- Contact hours for Tutorials: $32 \times 2 = 64$ hours

ASSESSMENT METHODS

1. **Class Test 1:**
 - Course Topics: 1-3
 - SEQs -30 marks
 - After about 10-12 weeks of teaching

2. **Class Test 2:**
 - Course Topics: 4-6
 - SEQs -30 marks
 - After about 20-24 weeks of teaching

3. **Class Test 3:**
 - Course Topics: 7-11
 - SEQs-30 marks
 - After about 30-33 weeks of teaching

4. **Practical Tests:** Near end of session

5. **Sendup Examination:**
 - Complete Course
 - MCQs & SEQs
 - MCQs: 30 marks, SEQs: 60 marks, Total: 90 marks
 - at end of teaching session

6. **Professional Examination:**
 - Complete Course
 - Theory: MCQs & SEQs
 - Viva Voce & Practical Examination
 - Total: 200 marks
 - Theory: 100 marks (MCQs: 30, SEQs: 60, Internal assessment:10)
 - Oral & Practical: 100 marks (Viva: 70, Practical 20, Internal assessment:10)
 - 1 month after sendup

TABLE OF SPECIFICATIONS

SECOND PROFESSIONAL MBBS EXAMINATION:

CONTENTS	SEQs (MARKS)	MCQs
1. Bioenergetics and Biologic Oxidation	0.5 (3)	1
2. Carbohydrates Metabolism	1.5 (9)	4
3. Lipid Metabolism	1.5 (9)	4
4. Metabolism of Proteins and Amino Acids	1 (6)	4
5. Metabolism of Purines ,Pyrimidines ,and Nucleotides	0.5 (3)	2
6. Replication of DNA ,Mutation, DNA repair and Basis of Genetics	1 (6)	3
7. Transcription, RNA processing and Proteins synthesis Regulation of gene expression, Genetic diseases, Basic techniques used in molecular genetics.	1.5 (9)	5
8. Endocrinology (General and Specific)	1 (6)	2
9. Water, Electrolytes & Acid-base disorders	0.5 (3)	3
10. Cancer and Xenobiotics	0.5 (3)	1
11. Biochemistry of Digestive Tract	0.5 (3)	1
Total items	10	30
Total Marks	60	30

Total Marks for Theory Paper: SEQ+MCQ

60+30=90 Marks

Note:

Minor variations can be possible in the final paper.

INTERNAL EVALUATION

Total Marks for Internal Evaluation: 20

At end of session, Internal Evaluation or Assessment is calculated as follows:

- 50% of total attendance
- 50% test marks + sendup marks

Marks of internal evaluation/assessment is added in professional examination.

CODE OF CONDUCT - ATTITUDE

- Uniform

The students must wear the prescribed uniform of the institution, and white coats while attending class rooms, laboratories, dissection hall and the hospital.

- Attendance

1. Every student shall be required to attend at least 75 per cent of the lectures, seminars, tutorials, practical and clinical classes of each subject in each class failing which his/her name shall not be forwarded to the Controller of Examination, of the University for the purpose of appearing in the concerned examination.

2. The margin of twenty five per cent of absence in theoretical, lectures, practical classes and demonstrations and in hospital practice is intended to cover absence only on account of sickness or special emergency considered justifiable by the head of the institution. A written application should be sent to the head of the institution by the student or his/her parent or guardian, reporting his/her illness or cause of absence.

3. Every student is required to attend punctually at the hours notified for lectures, demonstrations, seminars, tutorial classes, practical and hospital wards. Students absenting themselves from college or hospital work shall be liable to a fine imposed by the head of the institution.

4. Students have to be present in time at any specified activity of the institution.

- Class Room

1. Students are expected to extend highest level of courtesy and respect towards their teachers.

2. No student is allowed to leave the lecture room without the permission of his teacher or until the class is dismissed.

3. Immediately after assembly of the class, the roll call will be taken. A student coming late into the class room will be marked absent unless his excuse is accepted by the teacher. Any student misbehaving in the class room shall at once be reported by the teacher to the Head of the Institution, who will take such action as he may deem fit.

4. Students are not permitted to remain in the lecture room except during the prescribed hours of lectures.

- Class Examination

1. Students are not allowed to take into the examination hall textbooks, notes or manuscript of any kind.
2. Any student found infringing the examination rules or having recourse to unfair means may be expelled from the examination and the matter shall be reported to the head of the institute who may refer his case for action to the disciplinary committee.
3. Late comers arriving at the examination hall more than 15 minutes after the start of the paper will not be allowed to enter the examination hall.

- General Rules

1. Students are required to observe order and discipline at all times in the institution, attached hospitals and hostels.
2. Smoking within the institution, attached hospitals and hostels premises is entirely prohibited.
3. No game of any sort is to be played during the classes and hospital duty hours.
4. Displaying and distribution of partisan/ethnic/sectarian/political pamphlets or circulars etc, in the institution, attached hospitals and hostels premises is not allowed.
5. All irregularities, neglect of duties and breach of discipline are to be brought to the notice of the head of the institution by the professors under whom the student is working.
6. Every student to whom books or other property of Government is entrusted shall be held responsible for their preservation in good condition and in the event of their being lost or damaged shall be required to replace them or repay their cost.
7. Any student breaking or damaging any property of the institution shall be required to pay the cost of repair or replacement.
8. In case of willful damage, he/she shall be punished under the disciplinary rules of the Institution.
9. If a student of the institution takes part in any political activity or conducts himself/herself in an unbecoming manner or in such manner as would interfere with the corporate life or educational

work of the institution, the head of institution may take any action he deems proper or bring the matter before the College Academic Council for proper action.

10. No person shall be invited to address a meeting or society in the institution premises without prior permission of the head of the institution. In all cases, the chair shall be occupied by a responsible person approved for the purpose by the head of the institution. The subject of debate shall be fixed after obtaining the approval of the head of the institution in advance.

11. No student shall address a Press Conference, nor write to the press on the political or related subject or matters concerned directly with the administration of the institution, University or any Government or Educational Institution in Pakistan or abroad. No poster or banner shall be put up without the approval of the head of the institution.

12. No society may be set up by the students nor any meeting held in the institution premises without the written permission of the head of the institution.

13. No riots, strikes, boycotts and demonstrations are allowed.

FEEDBACK

STUDENT FEED BACK PROFORMA FOR BIOCHEMISTRY				
Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Q.1 Learning objectives were clear				
Q.2 Course workload was manageable & well organized				
Q.3 Attendance during the whole course covered				
Q.4 I participated actively in the course				
Q.5 I think material delivered was understandable				
Q.6 Class start in time & a good balance between Lectures, tutorials and practicals				
Q.7 Use of teaching Aids encourage participation				
Q. 8 Class room environment is satisfactory & conducive				
Q.9 Learning material (Lesson plan, course notes) was relevant and useful				
Q.10 Recommended reading books were appropriate and adequately available in library				

SUGGESTED BOOKS

RECOMMENDED BOOKS:

- Harper's illustrated Biochemistry by Murraray RK, Granner DK and Rodwell VW, Latest edition , McGraw Hill.
- Lippincott's Illustrated Review: Biochemistry by Harvey R and Ferrier D, Latest Edition, published by Lippincott William & Wilkins.

REFERENCE BOOKS:

- Lehninger Principles of Biochemistry by David L Nelson and Michael M. Cox 5th /6th edition.
- Marks' Basic Medical Biochemistry –A clinical Approach, by Smith C , Marks AD , and Lieberman M . Latest edition , published by Lippincott Williams & Wilkins
- Practical's and Viva in Medical Biochemistry by Dandekar SP and Rane SA, latest edition , published by Elsevier.
- Fundamentals of Biochemistry life at Molecular Level by Donald Voet, Judith G Voet and Charlotte W.Pratt.
- Text book of Biochemistry with Clinical Correlations by Devlin TM, latest edition , published by Wiley –Liss.
- Biochemistry by Berg JM, Tymoczko JL , and Stryer L , latest edition , published by W.H Freeman and Company
- Clinical chemistry and Metabolic medicine by Martin A. Crook , Latest edition , Edward Arnold (Publishers) Ltd
- Tietz Textbook of Clinical Chemistry by Burtis CA and Ashwood ER publishes by Saunders.

ONLINE RESOURCE:

- Online Journals and Reading Materials through HEC Digital Library Facility.
- ACS Journals (Amirical Chemical Society)
- Science Direct
- Wiley online

COURSE INSTRUCTORS

- **Prof. Dr. Muhammad Shakil**

- MBBS, M.Phil, MCPS, PhD (Biochemistry)
- Professor, HOD, Dept.Of Biochemistry, KEMU Lahore

- **Dr. Faiza Irem**

- MBBS, M.Phil (Biochemistry), MCPS-HPE
- Associate Professor, Dept.Of Biochemistry, KEMU Lahore

- **Dr. Amina Ihsan**

- MBBS, M.Phil (Biochemistry)
- Assistant Professor, Dept.Of Biochemistry, KEMU Lahore

- **Dr. Mehwish Iftikhar**

- MBBS, M.Phil (Biochemistry), PhD (Biochemistry)
- Assistant Professor, Dept.Of Biochemistry, KEMU Lahore

- **Dr. Sehrish Lodhi**

- MBBS, M.Phil (Genetics & Mol Biology), M.Phil (Biochemistry)
- Assistant Professor, Dept.Of Biochemistry, KEMU Lahore

- **Dr. Ammara Niaz**

- MBBS, M.Phil (Biochemistry)
- Demonstrator, Dept.Of Biochemistry, KEMU Lahore

- **Ms. Amber Nawab**
 - M.Phil (Biochemistry)
 - Biochemist, Dept.Of Biochemistry, KEMU Lahore

- Other facilitators according to their posting and designation